APPARATUS AND METHOD FOR GUIDING AND ALIGNING CIRCUIT BOARD ASSEMBLIES TO A BACKPLANE

Field of Invention

This invention relates to apparatus and a method for guiding and aligning circuit board assemblies with sockets of a backplane. This invention further relates to a method and apparatus that supports circuit board assemblies of electronic apparatus and which also guides and aligns a plug on the circuit board assemblies with mating openings of sockets on a backplane.

Problem

Electronic systems such as large computer systems and communications switching systems make extensive use of circuit board assemblies. These systems typically comprise a plurality of circuit board assemblies that must be electrically interconnected with each other. The mounting and interconnection of the plurality of circuit board assemblies is accomplished in the prior art by the provision of a frame having a plurality of horizontal shelves arranged in a bookshelf configuration with the circuit board assemblies being positioned vertically between grooves of vertically adjacent horizontal shelves. The vertical spacing between adjacent shelves is fixed and can only accommodate circuit board assemblies of a fixed height. The use of circuit board assemblies of different heights requires that circuit board assemblies of a larger height be positioned between a first pair of shelves having the required spacing, that circuit board assemblies of an intermediate height be positioned between a different pair of shelves having a spacing that accommodates the intermediate vertical height and that circuit board assemblies of a lesser height be positioned between another pair of shelves whose spacing accommodates the lesser height. A vertical backplane having sockets is positioned proximate the rear of the assembly of shelves. Sockets on the vertical backplane are adapted to interconnect with mating plugs on the circuit board assemblies mounted between the horizontal shelves.

The insertion of a circuit board assembly into a backplane socket requires that the circuit board assembly be positioned between the pair of shelves whose spacing is appropriate for the height of the circuit board assembly. Each circuit board assembly is positioned in the grooves of its pair of shelves and is then pushed towards the backplane until the pins on the rear of a plug of the circuit board assembly engage

mated openings in a socket of the backplane. This operation that must be done with precision to avoid damaging the pins of the plug while inserting them into openings of the socket. Typically the circuit board assemblies are guided on their top and bottom edges by the grooves in the top and bottom of the shelves to align pins of the plug with mating openings in the backplane sockets. The sockets of the backplane are interconnected by printed wiring on the backplane so that the plurality of the circuit board assemblies are interconnected with each other in the manner required to define an operable system. The alignment of the circuit board assembly pins with the sockets on the backplane is a critical operation due to the small tolerance involved. Any misalignment of parts can result in damage that renders an expensive circuit board assembly and/or its backplane socket useless.

The arrangements of the prior art have the disadvantage that spacing between adjacent shelves is fixed and can accommodate only circuit board assemblies having the dimensions defined by the vertical spacing between each pair of shelves. This arrangement limits the flexibility of the mechanical implementation of the system since vertical shelf spacing for a new replacement circuit board assembly must often have dimensions identical to those of the circuit board assembly it replaces even though such dimensions might not be as advantageous as new technologies might permit.

It is therefore seen that the prior art arrangements of circuit board assemblies and the card cage structure including the alignment facilities is cumbersome and leads to unnecessary expense in the physical design of systems embodying circuit board assemblies.

Solution

The above and other problems are solved in accordance with the present invention in accordance with which a method and apparatus is provided for guiding and aligning circuit board assemblies for mating with sockets mounted on a backplane of an electronic system. The apparatus embodying the present invention eliminates the horizontal shelves of the prior art arrangements. The elimination of the horizontal shelves is advantageous in that it overcomes the limitation that the circuit board assemblies must be grouped by sizes and inserted between pairs of shelves having the vertical spacing required to accommodate each different size.

In accordance with the method and apparatus of the present invention, the sockets into which sockets of circuit board assemblies are inserted are mounted in a

pattern of horizontal rows and vertical columns on the backplane. A vertically oriented guide plate is positioned between a column of sockets. Each vertical guide plate has horizontal guide slots that receive guide posts affixed to the vertical sides of a circuit board assembly. A circuit board assembly is supported by a guide plate by the steps of inserting guide posts on the circuit board assembly into a horizontal guide slot and by pushing the circuit board assembly inwardly toward the backplane until a plug at the rear of the circuit board assembly is proximate the backplane socket into which it is to be engaged. The rear surface of the plug has pins adapted to be inserted into corresponding openings in the sockets. The plug has ribs on each side which are adapted to mate with matching slots in the vertical sides of the socket that receives the plug.

The vertical guide plates and their horizontal guide slots perform the dual function of receiving and supporting a circuit board assembly as well as the function of guiding the plug on the rear of the circuit board assembly inward toward the socket into which it is to be inserted.

The guide slots and the guide posts on the circuit board assembly guide and align the circuit board assemblies as they are pushed inwardly until the rear portion of the plug begins to engage the socket into which the plug is to be inserted. At that time, a rear guide post of the circuit board assembly is within a rear guide hole formed in the guide plate at the rear extremity of the guide slot. The rear guide hole is substantially larger than the rear guide post of the circuit board assembly. This enables the rear portion of the circuit board assembly to move a limited amount vertically as well as horizontally with the front guide post acting as a pivot point for the motion of the rear of the circuit board assembly. This slight motion is desirable so that ribs on the vertical side walls of the plug at the rear of the circuit board assembly can mate with slots on the vertical side walls of the socket into which the plug is to be inserted. The circuit board assembly and its plug is fully inserted into its associated socket when the circuit board assembly is moved further inward so that the pins on the rear surface of the plug mate with corresponding openings in the socket.

The apparatus and method embodying the present invention eliminates the use of the library type horizontal shelving of prior art arrangements by using the vertical guide plates having horizontal guide slots to support the circuit board assemblies and to achieve accurate alignment and engagement with sockets on the backplane. The elimination of the horizontal shelving of the prior art equipment provides better air flow

over the circuit board assembly for cooling because no alignment channel is obstructing the air flow. This provides better tolerance control for inserting the plug of the circuit board assembly with the backplane socket because the dimensions are smaller and confined to single parts. This allows circuit board assemblies of the different heights to be guided into engagement with a socket by using the guide slots of the vertically oriented guide plates. This is further advantageous in that it provides potential for electromagnetic shields between adjacent circuit board assemblies of adjacent columns.

The apparatus and method embodying the present invention is further advantageous in that the rear openings at the rear extremity of the horizontal guide slots releases the circuit board assembly guiding function when the mating facilities of the sockets and associated guide pins on the plugs are engaged. This allows the plug and its socket to take over the guiding of the pins of the plug into openings of the socket. This also allows for the positioning of the alignment devices close to the circuit board connector fields to reduce the affect of board warpage. The apparatus and method of the present invention is further advantageous as it uses simple parts design and reduces the cost and complexities of the prior art card cage arrangements used to mount circuit wiring board assemblies and ensure their alignment with mating connector sockets of the backplane.

Description of the Drawings

The above and other advantages and features of the invention may be better understood from a reading of the following detailed description thereof taken in conjunction with the drawings in which:

FIG. 1 illustrates the position a circuit board assembly when it is initially engaged with guide slots of a guide plate.

FIG. 2 is similar to FIG.1 except that it illustrates the position of the circuit board assembly when it is further inserted into its associated guide slot.

FIG. 3 illustrates the circuit board assembly when it is further inserted so that its plug is immediately proximate a socket into which the plug is to be inserted.

FIG. 4 shows the plug fully inserted into its socket .

FIG. 5 is a left oblique view that shows the left side of a guide plate . FIG. 5 also illustrates the guide posts engaged in a guide slot. FIG. 5 further illustrates the slots of a socket which mate with guide ribs on a plug. FIG. 5 also illustrates the position of the

circuit board assembly at a location corresponding to the view of FIG. 3 in which the rear portion of the plug is beginning to engage its socket.

FIG. 6 is comparable to the view of FIG. 4 in which the plug is fully inserted into its socket. FIG. 6 also shows guide posts of the circuit board assembly and illustrates how the rear most guide post is within the confines of the rear guide hole.

FIG. 7 illustrates further details of the view of FIG. 6.

FIG. 8 illustrates two different sizes of circuit board assemblies.

FIG. 9 is similar to the view of FIG. 1 except that it shows an additional guide plate located between a different pair of columns of backplane sockets.

Detailed Description

Description of FIG. 1

FIG. 1 discloses a first possible exemplary embodiment of the invention. A plurality of sockets 102 are arranged in a row and column alignment on backplane 101. Also affixed to backplane 101 is a guide plate 103 which is vertically aligned with respect to the left-most column of sockets 102. Guide plate 103 is affixed to backplane 101 by tabs 108. Guide plate 103 has a plurality of horizontal guide slots 104 each of which is unique to a different socket 102. Circuit board assembly 110 has a front surface 115, a plurality of openings 112 and an upper surface 113, a pull knob 116 and RJ45 jacks 117. The rear of the circuit board assembly 110 includes a plug 111 having a rear portion (not shown) that includes pins which are adapted for engagement with corresponding openings in the socket 102 into which plug 111 and its pins are to be inserted.

Circuit board assembly 110 has a front guide post 114 and rear guide post 114 affixed to its left side on FIG 1. The rear guide post 114 is shown partially engaged with the front extremity of a guide slot 104. The front end portion of guide slots 104 has flared elements 119 and 120 to facilitate the insertion of guide posts 104.

The view of FIG. 2 is similar to that of FIG. 1 except that the circuit board assembly 110 is further inserted into its guide slot 104. On FIG. 2, both guide posts 114 are shown engaged with a guide slot 104. The view of FIG. 3 is similar to that of FIG. 2 except that the circuit board assembly 110 is further inserted into its guide slot 104 so that its rear guide post 114 is proximate hole 105 at the rear extremity of guide slot 104. Also, on FIG. 3, ribs 109 of plug 111 are proximate the walls of the socket 102 into which they are to be inserted. The view of FIG. 4 is similar to that of FIG. 3 except that

the plug 111 is fully inserted into its socket 102. FIG. 3 and 4 show groove 105 in the left wall of socket 102.

Description of FIGS. 5, 6, and 7

FIGS. 5, 6 and 7 show the apparatus of FIG. 1 at an oblique angle which the left side of guide plate 103 is visible. This view also illustrates slots 122 on the right wall of sockets 102 which are adapted to mate with guide ribs 109 of plug 111 of FIG. 1. FIG. 5 also shows the outer axial extremity of guide posts 114 when engaged with a guide slot 104. The view of FIG. 5 is comparable to that of FIG. 3 in which the rear portion of plug 111 is proximate the outer extremity of its socket 102. FIG. 6 is similar to FIG. 5 except that it shows the circuit board assembly 110 fully inserted into its socket 102. At this time, its rear guide post 114 is within the confines of opening 105. FIG. 7 illustrates the view of FIG. 6 in further detail.

Description of FIG. 8

FIG. 8 illustrates various sizes of circuit board assemblies that can be accommodated by the apparatus of the present invention. The small circuit board assembly 110 of FIG. 1 is shown in the upper left hand portion of FIG. 8. FIG. 8 also shows a larger circuit board assembly 810 which has a pair of guide posts 114 on its upper portion of the side wall and a second pair of guide posts 114 on its lower portion of its side wall. The upper pair of guide posts is adapted to engage an upper guide slot 104 of guide plate 103. The lower pair of guide post 114 is adapted to engage with a lower guide slot 104. The use of an upper and lower pair of guide posts 114 securely mounts the larger circuit board assembly to its guide plate 103. The rear portion of circuit board assembly 310 (not shown) is similar to that of circuit board assembly 110 in that it also has a plug corresponding to plug 111 of the FIG. 1 adapted to be inserted into a socket 102. Elements 816 and 817 of Fig. 8 correspond to elements 116 and 117 of Fig. 1.

Description of FIG. 9

FIG. 9 is similar to that of FIG. 1 except that it illustrates a first and a second guide plate 103 which is shown connected between the sockets of a different pair of columns. The left most guide plate 103 corresponds to that shown FIG. 1 together with its smaller circuit board assembly 110. The right most guide plate shown on FIG. 9 is similar to left most guide plate 103.

The above description provides an exemplary embodiment of this invention. It is expected that those skilled in the art can and will design alternative embodiments that infringe on this invention as set forth in the claims below either literally or through the Doctrine of Equivalents.